

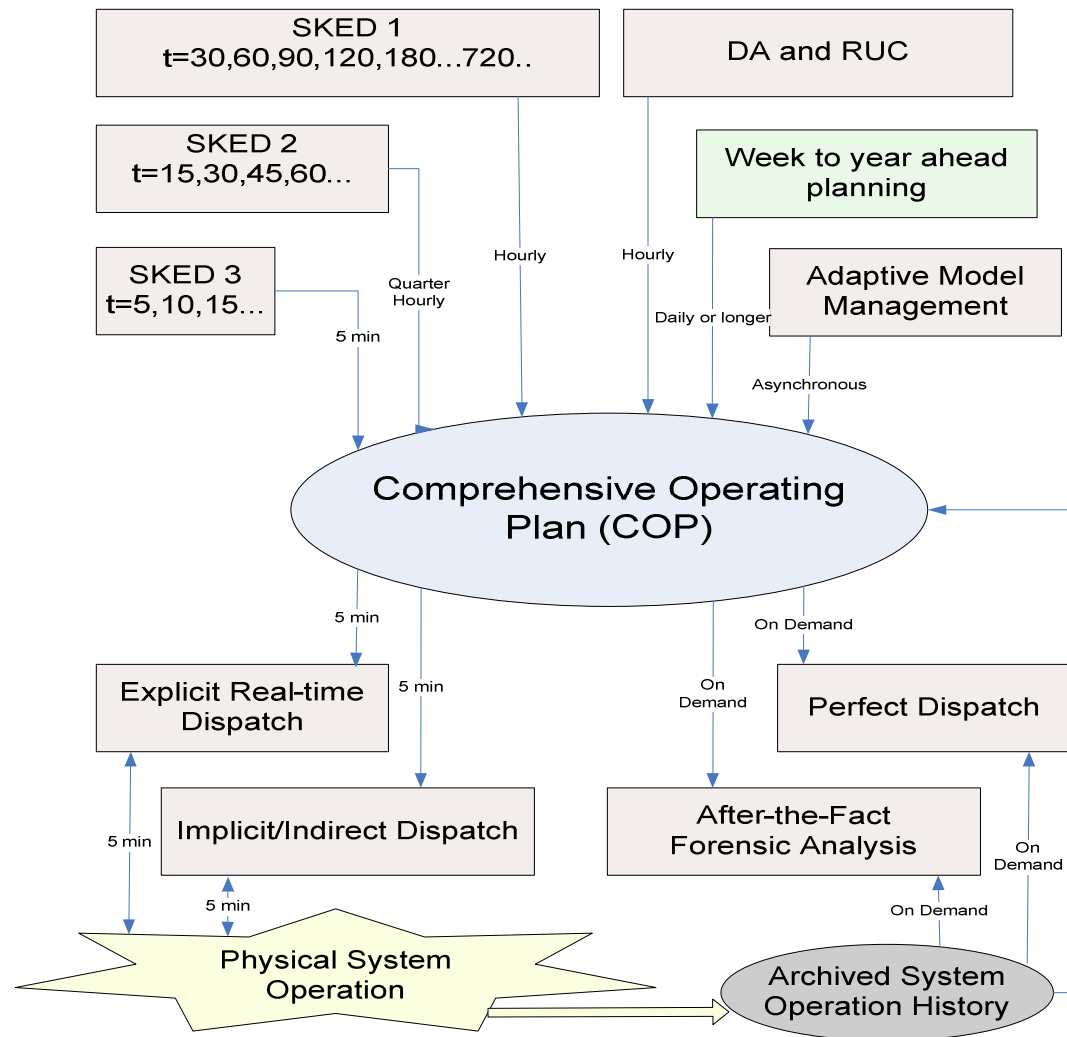
Smart Dispatch for Electricity Markets

Dr. Xing Wang

Dr. Avnaesh Jayantilal

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Smart Dispatch Overview



Commitment and Dispatch Evolution of Capabilities

▶ Classical Dispatch

- ◆ Unit Commitment Scheduling, Economic Dispatch, AGC
- ◆ Grid security, scheduling, dispatch are Independent tasks

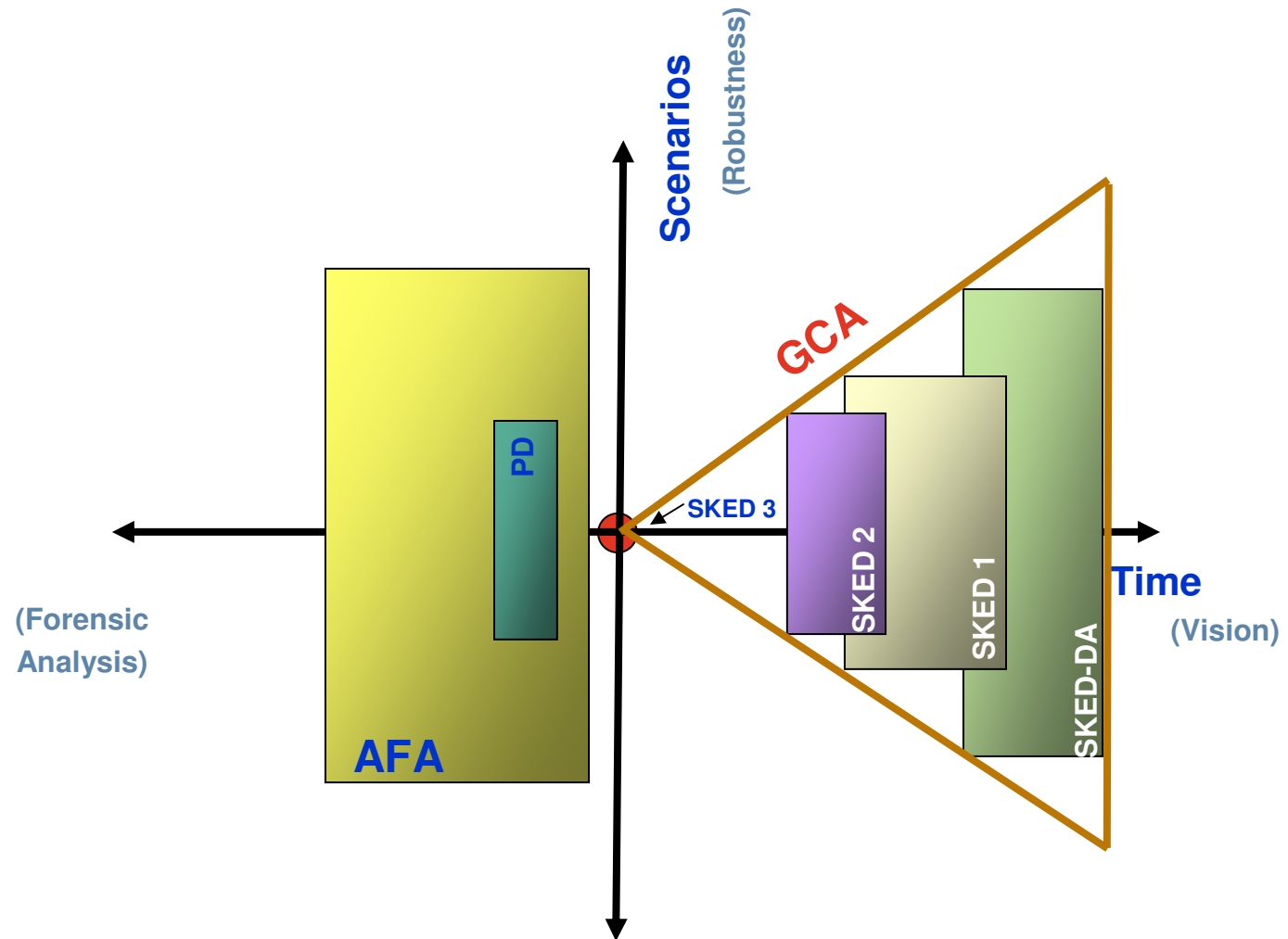
▶ Market-Based Dispatch

- ◆ UC/ED with explicit transmission security constraints
- ◆ Formal Day-Ahead and Real-time tasks
- ◆ Pricing - Dual of the MW signal
- ◆ Transparency & consistency
- ◆ Large-scale system dispatch

▶ Smarter Dispatch

- ◆ Dispatch with explicit forward vision
- ◆ Dispatch with intelligence (e.g. parameter adaptation)
- ◆ Improve system resiliency against uncertainties (e.g. DER, Wind, DR)
- ◆ Mitigate root-causes for dispatch deficiencies
- ◆ Process re-engineering for business/economic analysis

Dimensions of Smart Dispatch Applications

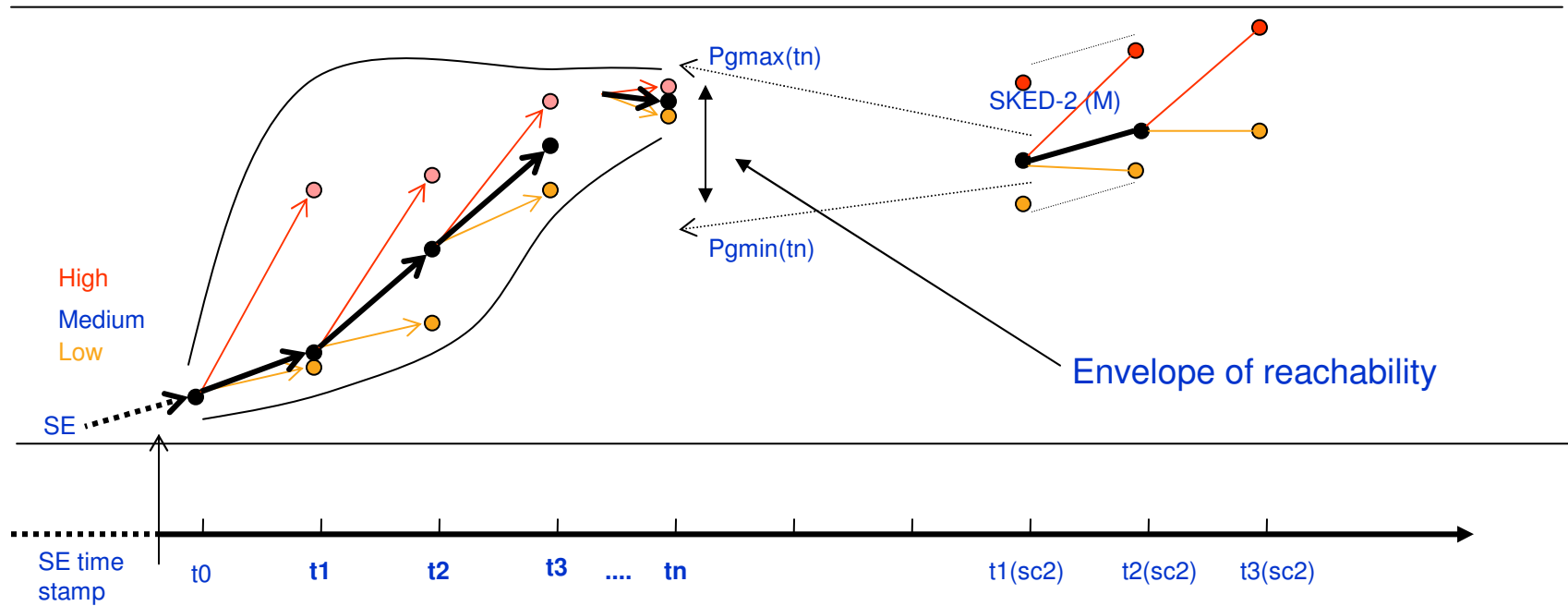


- ▶ **suggestions for near-term commitment changes several hours into the future,**
- ▶ **suggestions for regulation commitment changes,**
- ▶ **heuristically determined justifications for the commitment changes, and**
- ▶ **a view of anticipated power system operating conditions.**
- ▶ **evaluate capacity, ramp, ancillary service, and transmission sufficiency,**
- ▶ **apply analytical economic models which co-optimize energy and ancillary products to establish and explain commitment suggestions,**
- ▶ **provide representation of demand, interchange, wind generation, and other uncertainty in the future system state,**
- ▶ **enable real-time data to be incorporated for the best expectations of the future power system status,**
- ▶ **address intra-hour issues by studying near future term period in sub-hourly study intervals and suggesting commitment changes to address the intra-hour issues,**
- ▶ **provide the key information summarizing the complex analysis in a rich user experience that enhances the operator's situational awareness and providing efficient decision support,**

Comprehensive Operating Plan (COP)

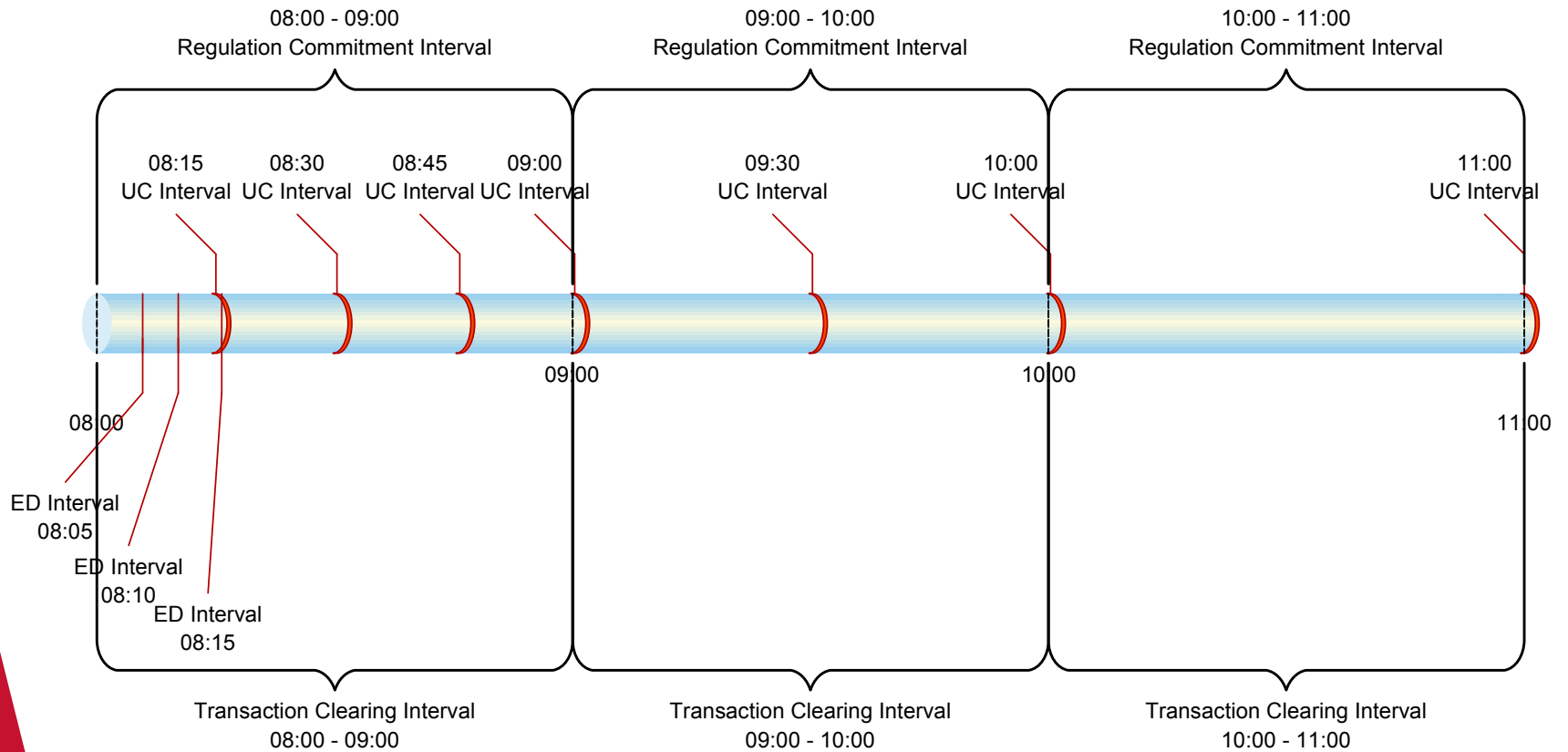
- ▶ **COP is driven by the need of operator decision support – When to make what decision and why.**
- ▶ **Why COP**
 - ◆ **Store and coordinate input/solution of SKEDs**
 - ◆ **Provide a modular framework for SKEDs' plug-n-play**
 - ◆ **Bridge between new SKEDs and existing business processes**
 - ◆ **Facilitate solution visualization for operators**
- ▶ **What's in COP**
 - ◆ **Resource schedules**
 - ◆ **Supplementary information**
 - ◆ **Variable time steps**
 - ◆ **Historical dispatch data**
- ▶ **COP provides coordination from planning to dispatch**
 - ◆ **Emission Constraint**
 - ◆ **Energy Constraint**

Coordination between SKEDs for Reachability



- ▶ **Unit commitment radar and likelihood**
- ▶ **Commitment justification**
- ▶ **Commitment and dispatch inertia**
- ▶ **Flexible time Indices for different decision variables**
- ▶ **Cross day boundary modeling**
- ▶ **Pricing of robustness**
- ▶ **Unit characteristics**
 - ◆ **MW dependent ramp-rate**
 - ◆ **Startup/shutdown profiles**
 - ◆ **Forbidden zone and holding points**

Flexible Time Indices for Different Decision Variables



Next Generation of Unit Commitment and Dispatch Application

- ▶ **Modular design to support UC, ED and other scheduling functions simultaneously**
- ▶ **Flexible and configurable formulation to support different market processes and rules**
 - ◆ **DA, RUC, AS, LA, RT, ...**
- ▶ **Resource modeling**
 - ◆ **Intermittent resources, Combined Cycle, Joint-Owned, Storage, Demand responses**
- ▶ **Uncertainty modeling**
 - ◆ **Traditional: LF, NSI**
 - ◆ **Emerging: Intermittent resources, Price Responsive Demand, ...**
- ▶ **Enhanced Computation Performance**
 - ◆ **Multi-core technology**
 - ◆ **Latest MIP performance improvements from different commercial solvers**

Thank You!